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The Rare Isotope Accelerator (RIA) is a proposed accelerator for the low energy nuclear physics community. Its goal is to understand the natural abundances of the elements heavier than iron, explore the nuclear force in systems far from stability, and study symmetry violation and fundamental physics in nuclei. To achieve these scientific goals, RIA promises to produce isotopes far from stability in sufficient quantities to allow experiments. It would also produce near stability isotopes at never before seen production rates, as much as 10^{12} pps. Included in these isotopes are many that are important to stockpile stewardship, such as ^{87}Y , $^{146-50}\text{Eu}$, and ^{231}Th . Given the expected production rates at RIA and a reasonably intense neutron source, one can expect to make ~ 10 μg targets of nuclei with a half-life of ~ 1 day. Thus, it will be possible at RIA to obtain experimental information on the neutron cross section for isotopes that have to date only been determined by theory.

There are two methods to perform neutron cross-section measurements, prompt and delayed. The prompt method tries to measure each reaction as it happens. The exact technique employed will depend on the reaction of interest, $(n,2n)$, (n,γ) , (n,p) , etc... The biggest challenge with this method is designing a detector system that can handle the gamma ray background from the target. The delayed method, which is the traditional radiochemistry method for determining the cross-section, irradiates the targets and then counts the reaction products after the fact. While this allows one to avoid the target background, the allowed fraction of target impurities is extremely low. This is especially true for the desired reaction product with the required impurity fraction on the order of 10^{-9} . This is particularly problematic for $(n,2n)$ and (n,γ) reactions, whose reaction production cannot be chemically separated from the target.

In either case, the first step at RIA to doing these measurements is production and collection of the desired nuclei. RIA offers two main isotope production methods. The Isotope Separation On Line (ISOL) method creates the isotope by bombarding a high-energy, low mass particle, usually protons, on to a high Z target. The target usually consists of foils and is kept at high temperatures to allow the produced isotopes to diffuse out. This method offers the highest production rates but the release fraction from the target is very chemistry dependent. The Fragmentation line bombards a high energy, high Z beam on a low mass target. The beam fragments are fed through a mass separator to select the desired isotope. This method offers a wider variety of isotopes, though at a reduced production rate. Also the selected nuclei leave the mass separator at high energies, ~ 350 MeV/A, which makes stopping the ions and maintaining purity a challenge.

Given the half-life of the targets, having a co-located neutron source is essential. The current concept is a tunable, "monoenergetic" source capable of providing neutrons from ~ 10 keV to 20 MeV. To achieve this energy range, a variety of reactions such as $^7\text{Li}(p,n)^7\text{Be}$ or d-d fusion would be used. Thus, at the heart of this facility would be two high current, low energy accelerators, a 3 MeV dynamitron and a 30 MeV linac. The dynamitron would be used for the low energy neutrons and the linac would be used for the high-energy neutrons. Radiochemistry facilities would also be part of the neutron source complex.